

**Title:** Biopile Remediation

**Lead PI/Affiliation:** NFESC

**Co-PI's/Affiliations:** ENSR

**Date/Duration:**

Initiated - 07/94

Completed - 09/98



**Abstract:**

Biopile remediation is an environmental cleanup technology that uses naturally occurring microbes such as bacteria and fungi to destroy organic contaminants in soil. Certain species of bacteria are able to consume organic pollutants as a food source, thus detoxifying the pollutants. If the process leaves only carbon dioxide and water as end products, biodegradation is complete, and mineralization is said to have occurred.

Contaminated soil is placed into engineered piles 8 to 12 feet high and approximately 50 feet long and 60 feet wide on a waterproof liner. Blowing air through the contaminated soil pile to provide oxygen and adding fertilizer to provide additional solid nutrients enhances the microbes' "appetite". Throughout the period of remediation, the soil is physically undisturbed while a proper environment is maintained to enhance and maintain acceptable rates of degradation.

The objectives of the bioremediation system demonstration included the following: (1) determine the need for pretreatment of soil (e.g., mixing, pulverizing), (2) optimize operating parameters (e.g. design and placement of aeration pipes, water and nutrient delivery, leachate collection, and offgas collection) of ex situ bioremediation systems, and (3) develop design and operation guidance for ex situ bioremediation systems to allow routine application of this remediation technology.

**Results/Conclusions:**

The ex situ bioremediation system successfully treated the petroleum hydrocarbon-contaminated soil to reduce total extractable petroleum hydrocarbons, TEPH, (diesel range) concentrations. During Test No. 1, the ex situ bioremediation system removed 88% of petroleum hydrocarbons in the diesel range and met the treatment objective of 250 mg/kg. Test No. 2, achieved a 72% reduction from an average 4,769 mg/kg TEPH to below 1,000 mg/kg waste oil range. In both Test No. 1 and Test No. 2, the largest reduction occurred during the first four weeks of soil pile operation. The TEPH degradation rates slowed dramatically after weeks six of operation.

**Publications:**

- (1) Major, W., et al., "D/NETDP Technology Demonstration Application Analysis Report for Ex Situ Bioremediation Treatment System", NFESC Technical Report TR-2063-ENV, April 1996.
- (2) Chaconas, J.D., et al., "Bioremediation of Diesel Contaminated Soil at the Navy National Test Site". Battelle, In Situ and On-Site Bioremediation Symposium, 4<sup>th</sup> International Symposium: Volume 1, Battelle Press. 1997.
- (3) Kodres, C.A., "Coupled Water and Air Flows Through a Bioremediation Pile", Environmental Modeling & Software, Volume 14, p.37-47, Jakeman, A.J. and A.A. Jennings Eds., Elsevier Science Ltd., 1999.
- (4) Von Fahnestock, F.M., et al., "Biopile Design and Construction Manual", NFESC, Technical Memorandum TM-2189-ENV, June 1996.
- (5) Von Fahnestock, F.M., et al., "Biopile Operations and Maintenance Manual", NFESC, Technical Memorandum TM-2190-ENV, June 1996.